

# Selection of Patients for Hand-Assisted Laparoscopic Surgery

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## ABSTRACT

**Each of the well-established approaches to laparoscopy—standard transperitoneal, standard retroperitoneal, and transperitoneal hand-assisted—has its advantages and disadvantages. In order to maximize efficiency and patient benefit, each approach should be used selectively. This paper offers recommendations for the selective use of the hand-assisted technique, which is particularly useful when intact specimen removal is required, the surgeon has limited experience, the situation is expected to be difficult (e.g., prior surgery, fibrosis, inflammation), or the patient's other medical comorbidities mandate a rapid procedure.**

## INTRODUCTION

**E**ACH OF THE THREE WELL-ESTABLISHED APPROACHES to laparoscopy—standard transperitoneal, standard retroperitoneal, and transperitoneal hand-assisted—has its advantages and disadvantages. Other approaches have been described (*retroperitoneal* hand-assisted, gasless, laparoscopically assisted minilaparotomy) but are not yet well established. In order to maximize efficiency and patient benefit, each of these approaches to laparoscopy should be used selectively (Table 1). The exact choice in an individual patient will be different for every surgeon, but some general guidelines are useful. In this paper, following a review of the published comparisons of hand-assisted laparoscopic surgery (HALS) with other laparoscopic techniques, considerations and recommendations for the selective use of HALS are presented.

## COMPARISONS OF HALS WITH OTHER LAPAROSCOPIC TECHNIQUES

When considering whether to perform HALS, there are two general comparisons to be made. First, is HALS preferable to open surgery? There is little disagreement that for many upper-retroperitoneal urologic operations, this is the case, given appropriate patient selection and sufficient expertise. The second comparison—is HALS preferable to standard laparoscopy?—is more controversial. Most of the data comparing the two techniques are from nonrandomized studies and therefore subject to bias.

The first published comparison of hand-assisted and standard transperitoneal laparoscopic nephrectomy was that of Wolf

and associates.<sup>1</sup> This study represented the first hand-assisted (N = 13) and standard (N = 8) transperitoneal laparoscopic nephrectomies performed at the University of Michigan and the University of Wisconsin. The hand-assisted approach was associated with an operative time 90 minutes shorter than that of standard laparoscopy without a significant difference in measures of convalescence (Table 2). Although the study was confounded by its retrospective nature and inclusion of different types of nephrectomies (simple, radical, and nephroureterectomy), it did suggest that, *early in a surgeon's experience*, HALS nephrectomy provides shorter operative times than standard transperitoneal laparoscopic nephrectomy. Also, HALS appeared to shorten the learning curve for transperitoneal nephrectomy. This study did not, however, provide information about the relative benefit of HALS in experienced hands.

A subsequent report from the University of Michigan sheds some light on what might be expected with this comparison as experience with laparoscopic nephrectomy is gained.<sup>2</sup> As of November 2000, 38 laparoscopic radical nephrectomies had been performed, 16 with standard transperitoneal laparoscopy and 22 with HALS. Although there were a variety of reasons for selecting HALS over standard laparoscopy, including a need for intact specimen extraction and the desire for a more rapid procedure, the most common reasons to select HALS were larger tumors, specimens, and bodies. As such, the tumor size, specimen weight, and body mass index tended to be greater in the hand-assisted group (Table 3), although the difference was statistically significant only for tumor size. Even with these differences, the mean operative time in the standard laparoscopic group was more than 60 minutes greater than in the hand-assisted group. This time benefit of hand assistance was greater

TABLE 1. SINGLE-SURGEON SERIES OF LAPAROSCOPIC NEPHRECTOMIES AT THE UNIVERSITY OF MICHIGAN (AUGUST 1996–MARCH 2003)

<i>Procedure</i>	<i>Total</i>	<i>No. (%) standard transperitoneal</i>	<i>No. (%) standard retroperitoneal</i>	<i>No. (%) HALS</i>
Simple	92	16 (17)	57 (62)	19 (21)
Radical	111	44 (40)	5 (5)	62 (56)
Nephroureterectomy	56	—	—	56 (100)
Donor	190	—	—	190 (100)
Partial	58	11 (20)	2 (3)	45 (78)
Total	507	71 (14)	64 (13)	372 (74)
Total (excluding donor)	317	71 (22)	64 (20)	182 (57)

in the first half of the series (90 minutes) than in the second half (30 minutes). This result supports the concept that with increasing experience, the time required for standard laparoscopy decreases—but that there is still a time benefit from hand-assisted compared with standard transperitoneal laparoscopic nephrectomy. With regard to convalescence, there was no increase in morbidity in the hand-assisted group out to 6 weeks with the exception of a trend (not statistically significant) toward more pain specifically in the abdomen with hand assistance (Table 4).

Landman and associates<sup>3</sup> retrospectively compared 11 standard transperitoneal laparoscopic and 16 hand-assisted laparoscopic nephroureterectomies. In this report, the different techniques were applied sequentially, as opposed to simultaneously, as in the study at the University of Michigan.<sup>2</sup> The patients undergoing standard transperitoneal laparoscopic nephroureterectomy were the last ones of a 7-year experience with the procedure, while the hand-assisted cases were done subsequently, representing the surgeons' initial experience with this approach. Nonetheless, hand assistance provided a 1.2-hour decrease in operative time. The length of the hospital stay (LOS) tended to be slightly longer in the hand-assisted group (3.3 v 4.5 days), although the difference was not statistically significant. Use of pain medications and other measures of convalescence were similar. This study suggests that for a complicated procedure such as nephroureterectomy, HALS is advantageous even in experienced hands.

To date, four nonrandomized, retrospective studies have compared 77 standard transperitoneal laparoscopic with 123 hand-assisted donor nephrectomies (Table 5).<sup>4-7</sup> The hand-assisted procedures tended to be faster, were associated with shorter warm ischemia time, produced fewer complications, required conversion less frequently, and were associated with a

shorter LOS. There were insufficient data to compare other parameters, but two of the studies suggested that postoperative narcotic analgesic use was greater by the HALS patients.<sup>4,7</sup>

There has been only one published comparison of retroperitoneoscopic and hand-assisted laparoscopic transperitoneal nephrectomy. Batler and associates<sup>8</sup> retrospectively assessed 24 consecutive laparoscopic nephrectomies (all but one radical) over a 2.5-year period. Similar to the study of Wolf and associates,<sup>1</sup> these cases represented the initial experience of the authors with these two techniques. Unlike the earlier study, however, the authors were already experienced in the technique of standard transperitoneal laparoscopic nephrectomy. The authors tended to use the hand-assisted approach for larger tumors (mean tumor volume 92 cc in hand-assisted v 25 cc in retroperitoneoscopic;  $P = 0.06$ ). As opposed to the aforementioned studies comparing hand-assisted transperitoneal and standard transperitoneal approaches, the authors found that the mean operative time with hand-assisted transperitoneal nephrectomy was only slightly shorter than that associated with retroperitoneoscopy (238 v 256 minutes;  $P = 0.54$ ). Measures of recovery were likewise similar. Although the time advantage of hand assistance was likely underestimated by the tendency to use this technique for larger tumors, these findings suggest that the hand-assisted approach may not have as much of an advantage over the retroperitoneoscopic route as it does over the standard transperitoneal one in terms of operative time.

Baldwin and associates<sup>9</sup> reported a retrospective comparison of 13 standard transperitoneal laparoscopic radical nephrectomies and 8 HALS radical nephrectomies in patients at high anesthetic risk (American Society of Anesthesiologists score 3 or 4), in which the primary surgeon already had more than 5 years' experience with standard transperitoneal laparoscopic radical nephrectomy. Given this experience, the operative time

TABLE 2. FIRST STANDARD TRANSPERITONEAL AND HAND-ASSISTED LAPAROSCOPIC NEPHRECTOMIES AT UNIVERSITY OF MICHIGAN AND UNIVERSITY OF WISCONSIN (JUNE 1996–AUGUST 1997)

	<i>Operating time (min)</i>	<i>Morphine use (mg)</i>	<i>LOS (days)</i>	<i>Return to nonstrenuous activity (days)</i>
Standard TP <sup>a</sup> (N = 8)	325	57	3.0	10
Hand-assisted (N = 13)	240	48	3.1	14
<i>P</i> value	0.04	>0.10	>0.10	>0.10

Data from reference 1.

<sup>a</sup>TP = transperitoneal.

TABLE 3. COMPARISON OF PATIENTS UNDERGOING DIFFERENT TYPES OF LAPAROSCOPIC RADICAL NEPHRECTOMY AT UNIVERSITY OF MICHIGAN (AUGUST 1996–NOVEMBER 2000)

	<i>Body mass index</i>	<i>Tumor size (cm)</i>	<i>Specimen weight (g)</i>	<i>Operating time (min)<sup>a</sup></i>
Standard TP <sup>b</sup> (N = 16)	26.7	4.1	386	270
Hand-assisted (N = 22)	29.1	6.3	658	205
<i>P</i> value	>0.10	0.006	>0.10	0.008

Data from reference 2.

<sup>a</sup>Hand-assisted procedure was 90 minutes faster in first half and 30 minutes faster in second half of series.

<sup>b</sup>TP = transperitoneal.

was equivalent (2.8 hours) in the two groups. Those authors found that analgesic use and recovery time tended to be greater in the HALS group, although not significantly so. It is likely that the extensive experience of the primary surgeon was responsible for the lack of improvement in operative time by HALS in this series.

Outside of urology, there have been two randomized clinical trials of standard transperitoneal and hand-assisted laparoscopic colectomy. The first, published in 2000,<sup>10</sup> included 40 patients operated on by 10 experienced surgeons. There were no differences in operative time (<3 hours in both), complications, or recovery parameters. Another trial, published in 2002,<sup>11</sup> detailed the outcomes in 54 patients. Again, there were no differences in operative time (<3 hours in both), complications, or recovery. In both studies, however, conversion to open surgery (or in the second study, to open surgery or HALS) was more frequent in the standard transperitoneal group (22% v 14%<sup>10</sup> and 22% v 7%<sup>11</sup>). The authors of both studies concluded that hand assistance enhances the ability of the surgeon to complete difficult laparoscopic procedures in a minimally invasive fashion.

Cost is another important consideration. Most of the current hand-assistance devices cost about \$450, making it one of the most expensive disposable devices on the table. However, use of hand assistance allows omission of at least one port, renders an entrapment sack unnecessary, and may reduce the need for clips and staples for some structures that can be controlled with other means when the hand is in the abdomen. Table 6 indicates the disposable laparoscopic instrumentation (not including tubing and other supplies common to both procedures) re-

quired for a hand-assisted laparoscopic donor nephrectomy (University of Michigan) and a standard laparoscopic donor nephrectomy (Johns Hopkins, University of Maryland). List prices are as provided by the manufacturers. The total cost of this instrumentation is \$1462 for hand-assisted, and \$1693 for standard, laparoscopic donor nephrectomy. Thus, in addition to cost savings owing to any reduction in operative time, HALS reduces supply costs for laparoscopic donor nephrectomy by 14%. In the University of Michigan study comparing standard and hand-assisted laparoscopic radical nephrectomy, the median intraoperative cost of the latter was 1% less than that of the standard laparoscopic approach, and the median direct inpatient cost was 2% less.<sup>2</sup>

To summarize this section, published data suggest that in a given surgeon's hands, HALS is usually faster than standard transperitoneal laparoscopy for appropriate procedures, or, if not, it at least it reduces the need for conversion to open surgery. This benefit may be less when HALS is compared with the retroperitoneoscopic approach and decreases with increasing surgeon experience. Conversely, for a complex procedure such as nephroureterectomy, HALS appears to offer an advantage even if there is considerable experience with standard laparoscopic techniques. The intensity and duration of postoperative recovery is likely increased slightly by HALS, but the magnitude of the difference between HALS and standard laparoscopy is much less than that between HALS and open surgery. If, on a scale of 1 to 10, 1 represents the convalescence of standard laparoscopy and 10 represents that of open surgery, then HALS is probably at about 2.5.

TABLE 4. MORBIDITY OF LAPAROSCOPIC RADICAL NEPHRECTOMY AT UNIVERSITY OF MICHIGAN (AUGUST 1996–NOVEMBER 2000)

	<i>Overall pain at 2 weeks</i>	<i>Abdominal pain at 2 weeks</i>	<i>Time to normal, nonstrenuous activity (min)</i>
Standard TP <sup>a</sup> (N = 16)	4.0	2.4	14
Hand-assisted (N = 22)	3.5	4.1	14
<i>P</i> value	>0.10	0.07	>0.10

Data from reference 2.

<sup>a</sup>TP = transperitoneal.

TABLE 5. PUBLISHED SERIES COMPARING STANDARD TRANSPERITONEAL LAPAROSCOPIC AND HAND-ASSISTED LAPAROSCOPIC DONOR NEPHRECTOMY

	<i>OR time (min)</i>	<i>Warm ischemia (min)</i>	<i>Minor/major complications</i>	<i>Conversion</i>	<i>LOS (days)</i>
Ruiz-Deya et al, 2001 <sup>4</sup>					
11 standard	215	3.9	1/1	0	1.6
23 hand-assisted	165	1.6	2/0	1	2.0
Lindstrom et al, 2002 <sup>5</sup>					
11 standard	270	5.0	3/0	0	6.5
11 had-assisted	197	3.6	0/0	0	6.2
Velidedeoglu et al, 2002 <sup>6</sup>					
40 standard	255	—	—	3	3.2
60 hand-assisted	260	—	—	1	2.6
Gershbein and Fuchs <sup>7</sup>					
15 standard	276	3.8	1/0	0	2.0
29 hand-assisted	205	2.4	2/0	1	2.3
Total					
77 standard	256 <sup>a</sup>	4.2 <sup>a</sup>	14%/2.7% <sup>b</sup>	3.9% <sup>b</sup>	3.2 <sup>a</sup>
123 hand-assisted	223 <sup>a</sup>	2.3 <sup>a</sup>	6.3%/0 <sup>b</sup>	2.4% <sup>b</sup>	2.8 <sup>a</sup>

<sup>a</sup>Weighted average.

<sup>b</sup>Percent occurrence of summed totals.

### GENERAL CONSIDERATIONS IN THE SELECTION OF HALS

Table 7 lists the typical advantages and disadvantages of HALS. The relative impact of these considerations will be different for every surgeon and also for various procedures. Table 8 lists the general situations in which HALS is most useful. The most obvious is when intact specimen removal is required. If an incision is going to be made for intact extraction of a kidney, it seems intuitive that the incision should be made at the outset of the procedure, rather than at its conclusion, if the surgeon can take advantage of that incision without a significant negative impact on patient convalescence. Incisions for specimen removal are typically made periumbilically, in the lower midline or transversely above the pubis (Pfannenstiel). The incision for HALS can be made in these same locations. Typically, the incision for specimen removal is at least 5 cm long (and usually more); a 7- to 8-cm incision for HALS in the same location appears to impact recovery minimally, although for some patients, the extra 2 to 3 cm is cosmetically unappealing.

Experience with a particular procedure is one of the most important factors in determining the general utility of HALS for given surgeon. For example, the first five HALS donor nephrectomies at the University of Michigan had a mean operative time of 254 minutes. The second five required a mean of 177. Although the primary surgeon for these cases had experience with open, laparoscopic, and hand-assisted nephrectomies, these were his first donor nephrectomies of any type. In this situation, HALS was associated with a significant decrease in operative time over a learning curve of just five cases. For a surgeon with more experience performing donor nephrectomy, the impact of HALS might be less. Bringing laparoscopic nephrectomy into the realm of immediate possibility for a laparoscopically naïve but otherwise skilled urologist is one of the greatest benefits of HALS. Thus, one of the strongest indications for HALS is surgeon inexperience—either with laparoscopy in general or with a new procedure. Some commentators have suggested that the surgeon who starts out this way

TABLE 7. TYPICAL ADVANTAGES AND DISADVANTAGES OF HALS COMPARED WITH STANDARD LAPAROSCOPY

	<i>Hand-assisted</i>	<i>Standard</i>
HALS device	450	—
5-mm port	104	104
10-mm port	130	130
12-mm port	135	135
15-mm port	—	145
Clip applier	220	220
Stapler	423	423
2 extra staple loads	—	367
Large entrapment sack	—	169
Total	1462	1693

#### Advantages

- Faster
- Easier
- More control in operating room by surgeon
- Better control of vascular injury
- Reduced need for conversion to open surgery
- Enhanced teaching

#### Disadvantages

- Larger incision
- Sometimes leakage of gas
- Sometimes necessitates suboptimal port placement
- Hand can get in the way
- Physical pain for surgeon
- Small increases in postoperative pain relative to standard laparoscopy

TABLE 8. GENERAL SITUATIONS IN WHICH HAND ASSISTANCE IS MOST USEFUL

Intact specimen removal required
Limited experience
<ul style="list-style-type: none"> <li>• With laparoscopy in general</li> <li>• With specific procedure</li> </ul>
Difficult situation
<ul style="list-style-type: none"> <li>• Large specimen</li> <li>• Reoperation</li> <li>• Perihilar mass that limits access to vasculature</li> <li>• Other process (inflammation, fibrosis, etc.) that render dissection difficult</li> </ul>
Medical comorbidities necessitate rapid procedure

will never “progress” to standard laparoscopy. While this may well be true for surgeons who perceive no significant patient benefit from standard laparoscopy over HALS (and therefore have no reason to alter their technique), for surgeons who are motivated to use even smaller incisions, this transition from HALS to standard laparoscopy can be and is readily accomplished.

An unusually difficult anatomic situation is another excellent indication for HALS. Large specimens, reoperation, poor hilar access, or any condition that renders the typical surgical planes or tissue identification indistinct can turn a procedure that is usually performed easily with standard laparoscopic techniques into one that is prolonged and complication prone. In some cases, HALS can make the difference between conversion to open surgery and completion of the procedure in a minimally invasive fashion. Finally, if HALS is indeed faster than standard laparoscopic techniques for a given surgeon, it might be useful for a procedure that otherwise would be approached with standard laparoscopy if a more rapid procedure is necessary because of medical comorbidities. Although very ill patients benefit greatly from the abbreviated postoperative recovery of minimally invasive surgery, the intraoperative physiologic stress of laparoscopy is greater than that of open surgery. Occasionally, there will be a patient who might have trouble with laparoscopy, usually owing to severe chronic obstructive pulmonary disease or congestive heart failure. In this setting, HALS provides more a rapid procedure while the patient still benefits postoperatively from minimally invasive surgery.

### PROCEDURE-SPECIFIC CONSIDERATIONS IN THE SELECTION OF HALS

Is HALS “better” than standard laparoscopy? The answer is yes in some ways, but no in others. Selective use of HALS is therefore appropriate. The technique should be selected when there is a clear advantage in terms of operative time, safety, specimen manipulation, etc. over standard laparoscopic techniques. The degree of advantage or disadvantage of HALS is determined for the individual surgeon.

The best procedures for HALS in urology are advanced extirpative renal procedures. Thus, HALS for radical nephrectomy is a good choice when the specimen is large or the anatomy is difficult. In other cases, standard transperitoneal or retroperitoneal techniques are effective. Similarly, in cases of partial

nephrectomy where the intra-abdominal hand would facilitate accurate resection, collecting system repair, or hemostasis, HALS should be considered. In general, laparoscopic partial nephrectomy will benefit from HALS more for central tumors than for peripheral ones. In cases of nephroureterectomy for urothelial carcinoma or live-donor nephrectomy, where intact specimen removal is required, many consider it more reasonable to use HALS than to perform the dissection with standard laparoscopy and then make the incision only at the end of the procedure for specimen removal.

In many other procedures, HALS may not be useful or may even hinder the procedure. Laparoscopic simple nephrectomy, where there is no concern regarding tumor violation, can be performed in a straightforward manner with standard transperitoneal or retroperitoneal techniques in most cases unless the specimen is very large (i.e., autosomal dominant polycystic kidney disease) or inflamed (i.e., pyonephrosis or xanthogranulomatous pyelonephritis). Adrenalectomy and renal cyst resection are likewise well suited for standard laparoscopic techniques in nearly all cases, and HALS offers little benefit. While some may find suturing during reconstructive renal procedures such as laparoscopic pyeloplasty or nephropexy easier with an intra-abdominal hand, the benefit is minimal, and the problems are easily overcome with practice. For these procedures, HALS might be a good way to gain experience, but standard laparoscopy is recommended once sufficient expertise is attained. Finally, the role of HALS in urologic pelvic procedures varies. The hand gets in the way during laparoscopic prostatectomy or pelvic lymph node dissection. There may or may not be utility for HALS for radical cystoprostatectomy, depending on the stage of the disease and the type of urinary diversion.

### CONCLUSION

Convalescence after HALS is minimally intensified/prolonged compared with that after standard laparoscopy. The HALS operation is technically easier than standard laparoscopy, with a shorter learning curve for most procedures. Unless there is extensive laparoscopic experience, HALS offers more rapid operating times and a tendency toward safer procedures than standard laparoscopy for most extirpative renal procedures. Given experience, HALS offers minimal if any improvement over standard laparoscopy for straightforward renal procedures, reconstructive procedures, and most pelvic procedures. A HALS approach is most useful for difficult extirpative laparoscopic procedures and when intact extraction is desired.

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1. Y SATO, H TANDA, S KATO, S ONISHI, H NAKAJIMA, A NANBU, T NITTA, M KOROKU, K AKAGASHI, T HANZAWA. 2005. 100-MINUTE RETROPERITONEOSCOPIC RADICAL NEPHRECTOMY: A NEW RETROPERITONEAL APPROACH WITH A HAND ASSISTED METHOD. *The Journal of Urology* **174**:1, 53-56. [[CrossRef](#)]